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ORIGINAL ARTICLE

Hybrid procedure for pyeloplasty in infants and young children with ureteropelvic junction obstruction is a safe and effective alternative

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Summary *Background:* Ureteropelvic junction obstruction (UPJO) is a common congenital urinary tract anomaly causing hydronephrosis in children. Laparoscopic pyeloplasty has become a popular and effective method to treat UPJO both in children and adults, but seems controversial in neonates or infants.
Materials and methods: From January 2007 to May 2012, patients with UPJO aged <18 years undergoing operations at our institute were included in this study. By retrospectively reviewing medical charts, the demographic data, presentation, laterality, etiology, operative time, length of hospital stay, stents, drainage tubes, and postoperative complications were recorded. Surgical outcomes were evaluated based on renal sonography and Lasix diuretic renography.
Results: A total of 47 patients (40 boys and 7 girls) were enrolled initially, but seven patients who were complicated with other congenital anomalies of the urinary system or who underwent surgery at other hospitals were excluded. Among these 40 patients, 21 had open pyeloplasty (Group I), eight who were younger than 1 year old or weighed <10 kg had a hybrid procedure (Group II), and 19 had laparoscopic surgery (Group III). The mean age was younger in Groups I and II because the selected procedure was nonrandomized. The operative time and

Conflicts of interest: The authors have no conflicts of interest relevant to this article.

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the duration of perianastomotic drainage were longer in Groups II and III. There was no significant difference with regard to successful resolution of UPJO among the three groups.
Conclusion: In infants or young children (<1 year old or weighing <10 kg) with UPJO, the hybrid procedure of pyeloplasty may be considered as a safe, effective, and less time-consuming alternative to laparoscopic surgery, and most importantly, confirms the security of the anastomosis.

1. Introduction

Ureteropelvic junction obstruction (UPJO) is the most common congenital cause of obstructive uropathy in pediatrics, which leads to progressive dilatation of the renal collecting system.[1–5] Treatments of UPJO consist of open pyeloplasty, procedures with laparoscopic approaches, and endourological methods.[6] Dismembered pyeloplasty of Anderson–Hynes is the standard management of UPJO. The overall success rate of open pyeloplasty is between 90% and 100%, which can be confirmed by improvement of symptoms, improved hydronephrosis on ultrasound, and stabilization or improvement of renal function on a radionuclide scan.[6–9] Endoscopic pyelotomy is a minimally invasive alternative, providing minimal pain, a short hospital stay and rapid recovery, but with lower success rates ranging from 70% to 89%, even in highly selected patients.[8,10] With advances in minimally invasive surgical techniques, laparoscopic pyeloplasty has been performed in both adults and children for nearly 20 years, and was first described by Schuessler in 1993 (adults) and then by Peters in 1995 (children).[4,5,11,12] Laparoscopic pyeloplasty has since been shown to be comparable to open pyeloplasty in success rates and operative time,[9,11–13] and now has the advantages of decreased pain, improved cosmetics, short hospital stay, and early return to full activity.[8,9,13]

We report our initial experience with all primary repairs of UPJO in children, and compared laparoscopic pyeloplasty to open pyeloplasty in the past 5 years. For infants and younger children with UPJO, a hybrid procedure of pyeloplasty was chosen to shorten the operative time and achieve secure anastomosis.

2. Materials and methods

From January 2007 to May 2012, patients with UPJO aged <18 years undergoing operations at our hospital were included. All patients underwent nonrandomly dismembered pyeloplasty of Anderson–Hynes, either by an open method, a hybrid procedure (for those aged <1 year or weighing <10 kg), or total laparoscopic pyeloplasty. For those treated with the open method (Group I), the patient was put in the lateral position with a flank incision, and traditional dismembered pyeloplasty was performed using interrupted 5-O chromic catgut sutures (Ethicon, Inc., Johnson & Johnson Company, New Jersy, USA). For those with the transperitoneal laparoscopic approach, the patient was put in the supine position with legs apart. A 5-mm 30-degree telescope (Karl Storz Endoscopy, Taipei, Taiwan) was inserted via a transumbilical port, and two or three work ports (5 mm) were made in the epigastrium and the lower abdomen in the midclavicular line with/without a third working port at the suprailiac site, as shown in Fig. 1A. For those treated with the hybrid procedure (Group II), the epigastric wound in the midclavicular line was enlarged to 2–3 cm in length to perform ureteropyeloplasty under direct vision after the obstruction site was clearly identified, as shown in Fig. 1B. In the total laparoscopic group (Group III), intracorporeal suturing was performed under video assistance (using interrupted 5-0 coated VICRYL™ (polyglactin 910) Sutures (Ethicon, Inc., Johnson & Johnson Company, New Jersy, USA)). Antegrade insertion of a double-J stent was performed in selected patients in Group I, but all patients in Groups II and III had double-J stenting. A perirenal drainage tube was placed in all patients.

The medical charts were reviewed. The demographic data, presentation, laterality, etiology, operative time, length of stay, stents, drainage tubes, postoperative fever, and major complications were recorded. The results were evaluated based on renal sonography and diuretic renography. Renal sonography and diuretic renography at 3 months after pyeloplasty showed improvement of renal dilatation and excretion in 18 patients. The patients were followed up at 3-month intervals using sonography. The collected data were analyzed by the χ^2 test and Kruskal–Wallis test.

3. Results

A total of 47 patients (40 boys and 7 girls) with UPJO were enrolled initially, but seven patients who were complicated with other congenital anomalies of the urinary system or who had undergone surgery at other hospitals were excluded. Among these 40 patients, 21 underwent open pyeloplasty (Group I), eight had a hybrid procedure (Group II), and 19 had laparoscopic surgery (Group III). The detailed data of the patients in the three groups are summarized in Table 1. Male patients and left-sided involvement predominated in the three groups, which is comparable with the incidence reported in the literature.[14] The mean age at the time of operation was significantly younger in Groups I and II than in Group III ($p < 0.001$), which is attributed to the surgeon's decision. The disorder in Groups I and II was mostly detected by prenatal sonography. By contrast, patients in Group III mainly presented with abdominal or flank pain, probably because their mean age was older. The duration of follow-up in the three groups ranged from 1 month to 52 months.

The operative results of the patients in the three groups are summarized in Table 2. There were no statistically

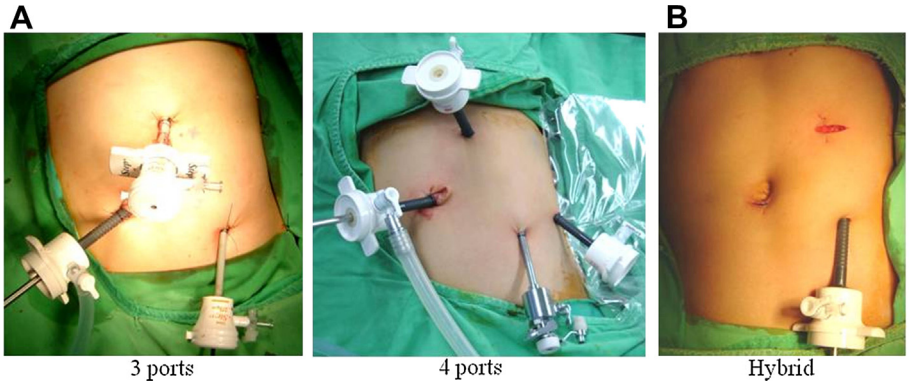

Figure 1 (A) The port sites in laparoscopic pyeloplasty for left ureteropelvic junction obstruction: three (left) or four (right) ports. (B) The wounds in a patient who underwent the hybrid procedure.

significant differences in the operative time between Groups II and III. Nevertheless, the operative time in Group II or III was longer than that in Group I ($p < 0.001$), which was correlated with the learning curve for laparoscopic surgery. Preoperatively, percutaneous nephrostomy drainage was performed on the decision of the pediatric nephrologist. The duration of perianastomotic drainage was longer in Group III than in the other two groups. A lot of serosanguious ascites was obtained from the drainage tubes in patients who underwent transperitoneal laparoscopic surgery, therefore, the drainage tubes were kept for a longer period of time. One patient in Group III had postoperative urine leakage, which was resolved by urinary diversion using percutaneous nephrostomy drainage. There was no shortening of hospital stay, but good cosmetic results and early return to normal activity were obtained. Successful resolution of UPJO was noted in almost all patients except one in the open surgery group, who was treated by "re-do" pyeloureterostomy. Resolution of UPJO was confirmed by improvement in ultrasound and diuretic renography.

4. Discussion

Since the first open pyeloplasty was performed by Trendelemburg in 1886, the open procedure has been the gold standard treatment with reported success rates of >95% at follow-up,[1–5] but with the disadvantages of postoperative pain, prolonged recovery, and long incision. Endopyelotomy, first described by Wickham and Kellet in 1983, is an alternative that provides a less-invasive treatment but lower success rate (40–70%) as compared to open pyeloplasty.[7] Besides, it is indicated only in patients with a small renal pelvis and a short UPJ stenosis or a significant stone with obstruction.[2,6,8,13] Since the late 1990s, there have been several reports of laparoscopic pyeloplasty in pediatrics using the transperitoneal or retroperitoneal approach.[4,9,11] In all pediatric patients, laparoscopic pyeloplasty may be performed safely, but is more difficult and time consuming in infants (<1 year old).[12,15,16] Tan[17] has suggested that laparoscopic pyeloplasty should not be considered in infants younger than 6 months. By contrast, some have demonstrated that laparoscopic pyeloplasty is safe and effective in young children aged >2 months.[4,9,12,15] In our patients, a hybrid procedure was nonrandomly performed in infants and young children due to the limitation of the surgeon's experience and should be considered as a safe, effective, and less-invasive alternative.

Postoperative complications had an incidence rate ranging from 11.7% to 24%,[3,5,6] and were usually related to urine leak and persistent drainage, and were often treated conservatively without sequelae.[9,10] Other complications, such as trocar hematoma, bleeding, misplaced stent, urinary tract infection, postoperative ileus, perirenal urinoma, anastomotic leakage, progression of the UPJ

Table 1 General data of the patients in the three groups.

	Group I (Open)	Group II (Hybrid)	Group III (Laparoscope)	*p*
No. of patients	21	8	11	
No. of renal units	23	8	11	
Sex (M/F)	20/1	6/2	8/3	0.127
Laterality (R/L)	6/17	1/7	1/10	0.434
Op age (mo)	16.2 ± 33.7	22.4 ± 24.4	83.7 ± 55.1	<0.001
Follow-up (mo)	24.7 ± 16.9 (1–52)	30.8 ± 8.7 (12–43)	23.7 ± 16.6 (1–13)	0.558
Presentations				0.002
Prenatal sono	17 (82.6)	6 (75.0)	4 (36.4)	
UTI	1 (4.3)	2 (25.0)	0	
Flank/abd pain	3 (13.0)	0	7 (63.6)	

Data are presented as *n* (%), mean ± SD, or mean ± SD (range).
abd = abdominal; F = female; M = male; L = left; Op = operative; R = right; sono = sonography; UTI = urinary tract infection.

Table 2 Operative results in the three groups.

	Group I (n = 23)	Group II (n = 8)	Group III (n = 11)	p
Op time (min)	133.0 ± 29.1	231.9 ± 89.0	259.1 ± 68.4	<0.001
Blood loss	minimal	minimal	minimal	
PCN	9 (39)	4 (50)	1 (9)	0.119
Stent	21 (91)	8 (100)	11 (100)	0.420
Drain (d)	2.8 ± 1.8	3.9 ± 1.5	4.9 ± 3.2	0.004
Hospital stay (d)	5.1 ± 2.2	5.4 ± 1.3	6.5 ± 2.8	0.129
Aberrant vessels	0	0	3	
Complications				
Urine leakage	0	0	1	
Failure	1	0	0	

Data are presented as n (%) or mean ± SD.
Op = operative; PCN = percutaneous nephrostomy.

anastomosis, and stricture formation have also been described.[13,16] The overall complication rate in our patients was only 4.8% (2 in 43 renal units) and 5.3% (1/19) in the pure laparoscopic group.

Laparoscopic pyeloplasty in children is definitely a safe and effective treatment option for primary UPJO in children. The laparoscopic techniques combine the comparably successful outcomes reported by open pyeloplasty with the advantages of a minimally invasive approach. It is technically challenging, but with increasing experience, the operative time will surely decrease. In infants or young children with UPJO, a hybrid procedure of pyeloplasty may be considered as an alternative to avoid time-consuming laparoscopic intracorporeal suturing, to shorten the learning curve for inexperienced surgeons, and most importantly, to confirm the security of the anastomosis.

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